Remarks

The following comments are provided in support of the claims presented.

1. § 103 Rejections

Claims 1-10 and 12-19 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Admitted Prior Art (APA) or Vawter et al (US 6,229,947) in view of Dutting et al (US 5,933,562) and Japan '405.

Applicants respectfully traverse the statement on page 2 of the Office Action (no paper number provided):

> The APA discussed in the background of the instant invention and Vawter et al. discloses a tapered rib optical waveguide in which the thickness of the waveguide core varying in proportion to the width of a mesa structure or substrate as being recited by the present invention.

as being unsupported by either Applicants' Background of the Invention section or Vawter et al. On page 1, line 25 through page 2, line 2, Applicants cite Vawter et al for disclosing a device having a "horizontal mode expansion" which is produced "by photolithographic patterning of one or more layers of the optical waveguide structure." Since the device of Vawter et al is photolithographically patterned after epitaxial growth of the various semiconductor layers therein, one skilled in the art will understand that Applicants' statement "photolithographic patterning of one or more layers of the optical waveguide structure" will only affect lateral features of a device and cannot change the thickness of any layers therein. Nothing in the APA or Vawter et al as cited by the Office above teaches or suggests Applicants' essential claim limitation of a "lower cladding layer being patterned to form a mesa structure having a width that varies with distance along at least a portion of the length of the optical waveguide, and with the thickness of the waveguide core varying in proportion to the width of the mesa structure."

Contrary to the requirement in Applicants' Claim 1 for "the lower cladding layer being patterned to form a mesa structure having a width that varies with distance along at least a portion of the length of the optical waveguide," Vawter et al

disclose devices having a lower cladding layer 13 of $Al_{0.2}Ga_{0.8}As$ and a mesa structure formed therefrom that is uniform (i.e. nonvarying) in width as shown in Figs 1A and 1B. This is further disclosed in col. 2, lines 30-33 of Vawter et al:

> Fabrication is relatively simple, requiring only patterning and etching of the tapered waveguide and **uniform-width outer mesa waveguide** without any epitaxial regrowth. (emphasis added)

Additionally, Vawter et al do not disclose any variation in thickness of the waveguide core as suggested by the Office. Thus, Vawter et al only disclose varying the width of a tapered rib structure with no teaching or suggestion of varying the thickness of any layers "in proportion to the width of the mesa structure" as required by Applicants' Claim 1. If any such teaching or suggestion is found in Vawter et al, it is incumbent on the Office to point this out explicitly for the record.

With regard to the APA, Applicants do not see anywhere in the Background section any discussion of "a tapered rib optical waveguide in which the thickness of the waveguide core varying in proportion to the width of a mesa structure or substrate" as suggested by the Office. Therefore, it is incumbent on the Office to point out for the record exactly where such disclosure exists.

The Office cites Dutting et al for teaching that "it is known to vary the thickness of the waveguide core with distance UB1 over a substrate."

Applicants respectfully submit that those skilled in the art would understanding that any variation in thickness of one or both of the two waveguide cores in Dutting et al occurs during epitaxial growth of the various layers and does not occur as a result of the width of a mesa structure as is required by Applicants' Claim 1. Thus, Applicants respectfully submit that there is no teaching or suggestion in Dutting et al for varying the width of a waveguide core "in proportion to" the width of a mesa structure as required by Claim 1. That the variation in thickness of the waveguide core in Dutting et al is totally unconnected to any variation in width of a layer therein can be seen from the devices shown and described by Dutting et al.

In the device of Figs. 1-3 in Dutting et al, one waveguide core (Bulk) varies in thickness over the length UB1, while a second waveguide core (MQW) has no variation in thickness at all. For this device, the width of the mesa structure (Ridge) as shown in Fig. 3 is constant. This provides evidence that there is no correlation at all between the thickness and width contrary to Applicants' requirement in Claim 1 that the thickness of the waveguide core vary "in proportion to" the width of the mesa structure.

The second device disclosed in Dutting et al in Figs. 4 and 5 includes one waveguide core (MQW) which decreases in thickness over a distance UB2 with the width of the mesa structure being constant; and a second waveguide core (Bulk) which increases in layer thickness at the same rate independent of whether the width of the mesa structure is constant or changing. This, too provides evidence that the variation in thickness of the two waveguide cores in Dutting et al is independent of the width of the mesa structure contrary to the requirement of Applicants' Claim 1. In Dutting et al, no explanation is provided about how the variation in layer thickness of the two waveguide cores is accomplished although one skilled in the art must assume that this occurs during epitaxial growth and prior to any patterning so that the variation in layer thickness in Dutting et al is completely independent of any patterning used to form the mesa structure. Each of the devices of Dutting et al as discussed above provide evidence for the *prima facie* unobviousness of Applicants' claimed invention of Claims 1-10 and 12-19 based on the combination of references set forth by the Office for the § 103 rejection of these claims.

With regard to Japan '405, Applicants respectfully submit that it is incumbent on the Office to provide an English translation in cases such as this where the Office relies on a figure with no clear understanding of the structure disclosed by that figure. Applicants submit herewith for the record several documents which Applicants' attorney has uncovered after receiving the current Office Action in order to better understand what is disclosed in the Japan '405 reference and in Fig. 4 therein. The document labelled "Exhibit A" is a computerized translation from the

Japanese Patent Office of the Japan '405 reference which shows this reference to be the published patent application of Autier et al corresponding to Japanese patent application No. 01-156920 and citing Priority No. 88 8808503. This document (Exhibit A) includes only an abstract and figure and does not include the entire disclosure of the application as provided by the Office in the Japanese language copy of Japan '405. Applicants further provide as "Exhibit B" a computerized translation of Japanese patent no. 06-075127 which issued from Japanese patent application No. 01-156920. Once the inventors of the above patent and published patent application became clear to Applicants' attorney, he searched for a corresponding U.S. patent claiming priority to 88 8808503 and found U.S. Patent No. 4,999,686 enclosed herewith as "Exhibit C." The Autier et al '686 patent shows the same Fig. 4 cited by the Office and provides an English version that is more readily understandable than the computerized translation of Japanese patent no. 06-075127. Applicants will direct their remarks to the Autier et al '686 patent which Applicants believe is essentially the same as the Japan '405 reference cited by the Office.

In the Autier '686 patent, Fig. 4 and cross-section views Figs. 5a, 5b and 5c taken along section lines A-A, B-B and C-C in Fig. 4, which are the same as those shown in the Japan '405 patent provided by the Office, show a variation in the width of layer "C_G" while the layers "R" and "C_1" remain fixed (i.e. unvarying) in width in order to reduce a radiative loss in a waveguide that includes a curved part. In these figures, three layers R, C_G and C_1 are shown, with the optical mode being confined primarily to guiding layer C_G. The Office in citing Fig. 4 state that "it is also known to vary a width of a mesa structure Q with respect to a waveguide." Applicants respectfully submit that the mesa structure Q in the Autier '686 patent and the Japan '405 patent is restricted to the guiding layer C_G and does not extend into lower confinement layer C_1. This is contrary to Applicants' Claim 1 which requires the lower cladding layer to be patterned to form a mesa structure. No such lower cladding layer forms a mesa structure in Fig. 4 of the Autier '686 patent. Furthermore, Applicants' Claim 1 requires that the thickness of the waveguide core

be "varying in proportion to the width of the mesa structure." Fig. 4 discloses that each layer is of a constant and nonvarying thickness contrary to the requirement in Claim 1 that the thickness of the waveguide core vary in proportion to the width of the mesa structure.

Applicants respectfully submit that the combination of the APA, Vawter et al, Dutting et al and Japan '405 would not lead one skilled in the art to form Applicants' claimed invention as recited in Claim 1 since none of these references teach or suggest the essential claim limitations of (1) a "lower cladding layer being patterned to form a mesa structure having a width that varies with distance along at least a portion of the length of the optical waveguide" and (2) a waveguide core "with the thickness of the waveguide core varying in proportion to the width of the mesa structure." Applicants further submit that the Office has not made a valid *prima facie* case of obviousness for the rejection of Claims 1-10 and 12-19 since the Office has not shown the requisite motivation for one skilled in the art to combine the various references cited in the § 103 rejection. Therefore, Applicants urge that Claims 1-10 and 12-19 are allowable.

With regard to Claims 2, 4 and 5, these claims recite the waveguide core as comprising "a spin-coatable material selected from the group consisting of polymers, sol gels, and spin-on glasses." Applicants respectfully submit that the art of record does not teach or suggest this essential claim limitation. The art of record is limited to waveguides formed from epitaxially-grown semiconductor materials with no teaching or suggestion of applicability to any spin-coatable materials including spin-coatable materials comprising polymers, sol gels, and spin-on glasses. Therefore, Claims 2, 4 and 5 are allowable.

With regard to Claims 6 and 7, these claims recite one or two silicon oxynitride etch-stop layers. The art of record does not teach or suggest any etch-stop layers in an optical waveguide device that are formed of silicon oxynitride. Therefore, since Claims 6 and 7 recite this essential limitation which is not taught or suggested in the art of record, then Claims 6 and 7 are allowable.

2. Objections to the Claims

Claim 11 has been objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants respectfully submit that since the Office has not made a valid *prima facie* case of obviousness for the rejection of base Claim 1, then it is not necessary to rewrite Claim 11 to place this claim in independent form. Reconsideration of the objection to Claim 11 is respectfully requested.

3. Claim Amendment

Applicants have herein amended Claim 5 to indicate that the indices of refraction of the upper and lower cladding layers are **smaller** than the index of refraction of the waveguide core. Support for this amendment can be found on page 3, lines15-18 and on page 11, lines 21-24. This amendment adds no new matter.

Conclusion

Applicants have responded to each and every rejection and objection, and urge that the Application is in condition for allowance. A favorable reconsideration is earnestly solicited.

Respectfully submitted,

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